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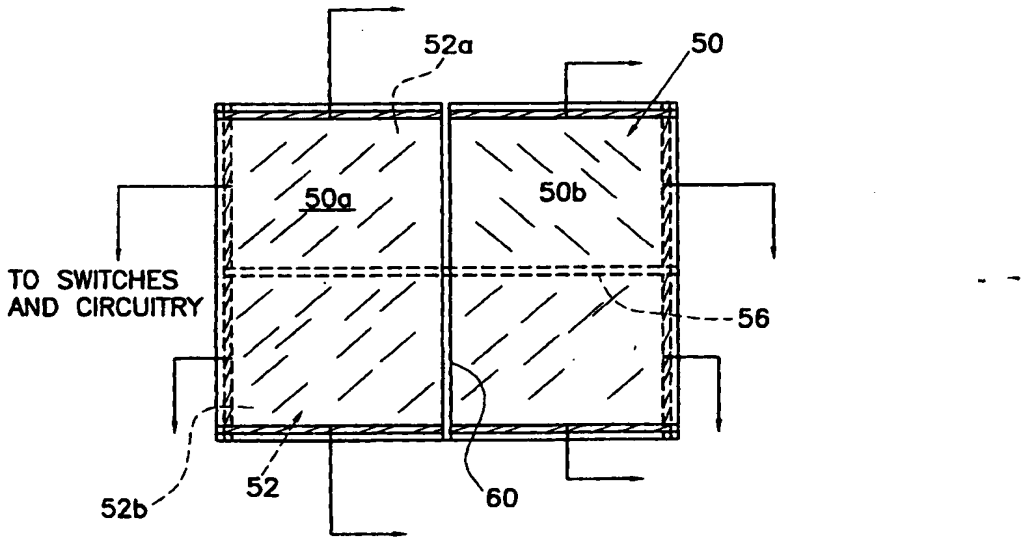

(57) Abstract

A resistive two sheet touchscreen that provides discrimination between objects touching the surface thereof. This is achieved by subdividing one sheet into a selected number of separated portions (50A, 50B, 52A, 52B) of selected configuration. Each of these portions is connected through a switch apparatus to circuitry for evaluating a signal on the separated portions corresponding to the position of touch. This switch can be utilized to deactivate any selected portion (50A, 50B) so that an object contacting this portion provides no signal to the circuitry. Any active portion that remains connected to the circuitry provides position information as with any touchscreen.

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Description

RESISTIVE TOUCHSCREEN HAVING MULTIPLE SELECTABLE REGIONS FOR PRESSURE DISCRIMINATION

Technical Field

The present invention relates generally to devices for providing information as to a location of a point in a two-directional array of information, and more particularly to an improved resistive touchscreen that permits a selection of areas of activation of the touchscreen whereby pressure discrimination between areas of touch against the touchscreen can be achieved.

Background Art

Many types of devices have been developed to provide information as to a location within a two-directional array of information. One simple device is a "touchscreen" having a pair of overlaid electrically conductive sheets that are subdivided so as to form a multiplicity of switches. With such a device, the touch of one of the switches causes some activation that is related to the position of the touched switch. Within each switch area, there is no discrimination of the actual point of touch.

More complex devices provide true information as to a location in a two-dimensional array of information. Such devices have been designated the terminology "touch-screens". Within this general designation, there are a multitude of types of devices for providing the positional information. Generally most fall within the category of "resistive" touchscreens where at least one of a pair of closely overlaid electrically conductives has a substantially uniform resistivity throughout. In one class of resistive touchscreens, both of the sheets have this resistivity characteristic and each sheet is sequentially electrically energized to have a locus of equipotential points, or equipotential lines on the resistive surface such that the lines in one layer are straight, and substantially orthogonal to those in the other. Where only one sheet is resistive, the equipotential lines are created by sequentially applying orthogonal voltages to edges of the resistive layer. In the single-layer resistive touchscreens, the second sheet is conductive and is separated from the resistive layer so that the conductive sheet has voltages thereon

only when it is touched to the resistive layer. These voltages provide the two coordinates for ascertaining the position of the contact.

Variations on resistive touchscreens have also included devices which added one or more separate non-position discriminating switches outside the viewable area of the touchscreen which would normally be associated with the video display viewed through the touchscreen or with the main target area of the system, in a non-video based application. Also, it is possible to greatly enlarge the sensitive area of the touchscreen such that additional target areas, typically associated with non-position discriminating switches, are defined outside the video display or main target viewing area, with the additional target area being defined for the user by graphics printed or embossed on the outer surface of the top conductive sheet, or by printed graphics viewed through the touchscreen. While these target areas are inherently position discriminating by virtue of being composed of a region of the touchscreen, their association with some specific system function, performed by system software, is a one-to-one association that causes the

indicated function to be performed regardless of the specific location touched within the target area. Thus, these additional target areas are not intended for, and are not capable of, position discrimination

It is normally desirable to prevent inadvertent touching of the two sheets that might occur because of gravity, curvature of the device, atmospheric conditions, etc. Toward this end it is conventional to separate the two sheets with small dots or islands of insulative material. These can be applied to the opposed faces of either or both of the layers. Then, because there has been a desire to differentiate between the size of the object touching the touchscreen, or to create a minimum activation force, specific spacing requirements have been applied for these islands of insulative material.

Several United States patents discuss the touchscreens of the prior art, and especially the specific spacing of islands of insulative material. Typical of such touchscreens are described in U. S. Patents: 3,911,215 issued to G. S. Hurst et al on October 7, 1975; 4,220,815 issued to W. A. Gibson et al on

September 1, 1980; 4,661,655 issued to W. A. Gibson et al on April 28, 1987; 4,731,508 issued to W. A. Gibson et al on March 15, 1988; 4,797,514 issued to J. E. Talmage, Jr. et al on June 10, 1989; 4,822,957 issued to J. E. Talmage, Jr. on April 18, 1989; 4,801,773 issued to M. Mizuguchi et al on January 31, 1989; and 5,220,136 issued to J. C. Kent on June 15, 1993. These patents are incorporated herein by reference as to any teaching that is pertinent to the present invention. Specifically, the '215, '655, '508, '514 and '957 patents teach various systems for energizing the resistive layer of each device. All of the cited patents, except the '773 patent, are assigned to Elographics, Inc., a predecessor to the assignee of the present invention.

As taught in the cited patents, and particularly '215 and '136, the spacing between the insulating islands can be chosen by specific relationships to discriminate between touch objects of differing size. For example, it is often desired to differentiate between the touch of a sharp stylus and a finger tip. In other applications, it may be discrimination

between a finger tip and a hand palm, for example. To prevent activation by a hand palm (or the edge of the hand) when it is desired to activate the touchscreen by an object of smaller size, a closer spacing of the insulating islands is utilized. Thus, the contact of the smaller-sized object is detected without activation by the larger object. However, when the touchscreen is to be utilized for writing or similar applications, in addition to "point and shoot" operation that might reasonably be accomplished entirely with a finger tip, the close spacing causes problems as the writing instrument encounters several positions of the insulating islands. Accordingly, this disadvantage of writing upon touchscreens having closely spaced insulative islands must be tolerated or a compromise between partial discrimination and substantially uninterrupted writing is chosen.

Accordingly, it is one object of the present invention to provide a resistive touchscreen wherein relatively widely spaced insulative separative islands can be utilized for enhanced writing capabilities while retaining a discrimination against objects

having a size greater than that used for the writing - specifically against larger objects such as the palm of a writer using the touchscreen.

Another object of the present invention is to provide a resistive touchscreen therein a conductive layer overlaying a resistive layer is divided into discrete regions while retaining a desired sensitivity at any position on the touchscreen.

A further object of the present invention is to provide a resistive touchscreen wherein a conductive layer overlaying a resistive layer is divided into discrete regions, with each discrete region being selectively connected into detection equipment so that regions where no response is desired can be isolated while leaving the remainder of the touchscreen operable for position determinations and/or an annotation or drawing.

These and other objects of the present invention will become apparent upon a consideration of the drawings referred to hereinafter and their complete description.

Summary of the Invention

In accordance with the present invention, there is provided a resistive touchscreen having multiple selectable sensitive regions for pressure discrimination. This is achieved in one embodiment by dividing a conductive cover sheet of a resistive touchscreen into electrically-isolated regions. In another embodiment which utilizes two resistive sheets, at least one of the resistive sheets is subdivided into isolatable regions. The entire touchscreens can be utilized as a single sensitive region, or at least one of the separate regions can be made sensitive and other regions made insensitive through the utilization of switching means. Thus, one or more regions can be made insensitive to provide palm rejection or other pressure discrimination when activation is desired only in the selected region of the touchscreen.

Brief Description of the Drawings

Figure 1 is an exploded view of a resistive touchscreen illustrating the present invention including a schematic diagram for its use.

Figure 2 is a plan view illustrating a coversheet of a touchscreen illustrated in Figure 1 for the present invention having a different embodiment than that illustrated in Figure 1.

Figure 3 is a plan view illustrating a coversheet of a touchscreen illustrated in Figure 1 for the present invention having a further embodiment.

Figures 4 and 4B are illustrations of a preferred form of resistor network/electrode configuration for introducing fields into a single layer of a resistor-type touchscreen of the type illustrated in Figure 1.

Figure 5 is an exploded view of another type of resistive touchscreen illustrating the present invention to provide discrimination.

Figure 6 is a plan view illustrating both layers of a resistive touchscreen as illustrated in Figure 5 employing the present invention providing regions of discrimination similar to that of Figure 2A.

Best Mode for Carrying out the Invention

Referring now to Figure 1, shown therein is an exploded view of one embodiment of a

device for accomplishing the above-stated objects. It will be recognized that the thickness (or height) of the components has been exaggerated for purposes of illustration.

A uniform resistive surface or layer **10** is applied to a suitable substrate **12**. Of course if the resistive surface **10** has sufficient rigidity, no separate substrate **12** will be required. The substrate **12** may be, for example, planar as shown. Further, the substrate **12** can be contoured as illustrated in U. S. Patent 4,220,815 so as to conform to the face of a curved object such as a conventional video display screen. The substrate **12** can have any selected perimeter configuration, e.g., rectangular as shown, a configuration to match the configuration of a video display, etc.

Orthogonal electrical fields are created within the resistive layer **10** using a voltage source within the circuitry **14** and applying the voltage across the resistive layer in the two directions in separate time periods. This application of voltage is achieved through the use of a resistor string or resistor element **16**

to which a plurality of electrodes **18** are attached at selected intervals (see Figures 4 and 4A). Corner junctions **15** of the resistor-electrode array **16** are joined to the circuitry **14** by leads **17**. Any one of several resistor-electrode combinations **16/18** can be utilized. Typical of such combinations are those of U. S. Patent Nos. 3,911,215, 4,661,655, 4,731,508, 4,797,514, and 4,822,957. In addition, potentials can be introduced into the resistive layer **10** by diode strings as is known in the art.

It is not necessary for purposes of the present invention that the fields be orthogonal. However, this is the most common type of resistor-type touchscreen.

Spaced above the resistive layer **10** is a conductive layer which, in accordance with the present invention has at least two conductive portions **20**, **20A** in this embodiment (see also Figures 2 and 3 for other typical embodiments). These two conductive portions are conventionally applied on the undersurface of an insulative cover layer **22**. These portions are separated by a very narrow insulative band

24. Conductive portion 20 is connected to a switch means 26 by lead 28, and then to the circuitry 14 with lead 30. It will be understood that although the switch means 26 has been illustrated as a mechanical switch, any form of switching means can be utilized with the present invention.

As illustrated for this embodiment of Figure 1, the conductive portion 20 is always connected to the circuitry 14 through the switch means 26. Of course, it will be understood that this connection can be selected through a contact within the switch means 26 so as to disconnect portion 20 from the circuitry 14.

The conductive portion 20A is connected to a normally open contact of the switch means 26 by lead 32. With this connection, conductive portion 20A is only connected to the circuitry 14 when the switch means 26 is closed. The effect of this selective operation of switch means 26 will be discussed in detail hereinafter.

The conductive portions 20, 20A are separated from unintentional contact with the

resistive layer **10** using, for example, a perimeter spacer **34**. They are further separated by spaced-apart small dots **36** of insulative material. These dots or islands **36** are normally arranged in a uniform manner; however, a non-uniform distribution is within the scope of this invention. Further, the dots **36** can be arranged in a rectangular array, or in a non-rectangular array as shown in U. S. Patent 5,220,136. In the present invention the maximum spacing between the dots **36** is governed only by the need to prevent inadvertent contact between the conductive layer portions **20**, **20A** and the resistive layer **10**. The dots **36** may be applied to either the layer **10** or the conductive layers **20**, **20A**, or to both surfaces.

Through the use of the multiplicity of conductive layer portions **20**, **20A** (or other combinations), some portions of the touchscreen can be made "active" while other portions are made "inactive" through operation of the switch means **26**. This will permit, for example, the use of a stylus of some type as for writing on one portion (e.g., **20**) without the portion of the hand holding the stylus (which rests on

portion **20A**) registering at all on the touchscreen. Since spacing of the dot insulators **36** can be larger, because area discrimination has been accomplished by the separate portions, the dot insulators **36** do not interfere with writing since fewer dot insulators **36** are encountered. Of course, the entire touchscreen can be made active by proper operation of the switch means **26**. As an example, the operation of the switch may be controlled by the use of a stylus "tethered" to the system. When the stylus is placed in a holder designed for that purpose, switch **26** is closed and the entire screen is active. When the stylus is removed, switch **26** is opened and only region **20** of the touchscreen remains active. This function is coordinated with the rest of the system operation such that appropriate indication of the use of only region **20** is signaled when the stylus is removed from the holder.

The configuration of the conductive portions **20**, **20A** is not limited to that illustrated in Figure 1. For example, they can have a configuration as illustrated in Figure

2. Further, there is no restriction as to the number of separate conductive portions. This is illustrated in Figure 3 where there are three conductive portions **20**, **20A**, and **20B**. Thus any number of conductive portions of any configuration can be utilized within the scope of the present invention. Each would be connected (or disconnected) by an appropriate switch means **26** to the circuitry **14** so as to select any one, any combination, or all of the portions of the touchscreen covered by the conductive portions to be made sensitive ("active") to a touch. Because the local resistivity of the conductive layer of the touchscreen has negligible effect on the linearity of the touchscreen, the discrete nature of the conductive regions **20**, **20A** (or **20B**, etc.) does not affect the linearity of the device as a whole. Generally the calibration of the system is accomplished when all conductive portions are active; however, this may not be necessary depending on the specific locations of the conductive portions.

Although any of the known systems for producing the orthogonal or position discriminating fields in the resistive layer

are useful for the present invention, a preferred system is that illustrated in Figures 4 and 4A (see U. F. Patent No. 4,731,508). Some of the components are enlarged in order to properly distinguish them in these drawings. In this embodiment, the resistive surface **10** extends substantially over the entire sensor. A resistance member **16** around the perimeter of the resistive layer **10** is made up of four resistance element segments **38** (one along each edge of the perimeter, but only two shown) each consisting of a plurality of resistors. Where resistance element segments **38** join at corners **15** of the resistive layer **10**, a connector **17** is provided for connection to the voltage in the circuitry **14**.

Conductive electrodes **18** attached to the resistive layer **10** are positioned along each edge, with each electrode being joined to an adjacent resistance element with a conductive connector or lead **40**. As discussed in the prior art (U. S. Patent Nos. 4,731,508 and 4,822,957) the spacing and effective lengths of the electrodes **18** are selected to produce a voltage gradient at each electrode to

compensate for any voltage drop that occurs along the resistance segments **38** perpendicular to current flow in the resistive layer **10**.

A method of preventing undesirable current flow between the resistance segments **38** to the electrodes **18** is to form a line of discontinuity where there is no resistive coating between the resistance segments and the electrodes. As illustrated at **42** (see particularly Figure 4A), this produces a central resistive area **10** and a peripheral resistive area **10A**, preferably having the same resistivity. This can be accomplished by either not depositing any resistive coating along that line **42** or removing the coating after application. In either case the leads **40** span the line **42** so as to connect the electrodes **18** with the resistive segments **38**.

Within each of these resistance segments **38** there is a plurality of discontinuous units **44**, with one such unit between each electrode lead **40**. Each of these units **44** is formed by a pair of overlapping conductive legs, as at **46**, **48**. These legs overlap a length, L, and are spaced apart a distance, D, (see Figure 4A).

The resistance produced for each unit **44** is a function of the spacing, D, the overlap length, L, and the resistance value of the resistive layer **10A**. There is no critical location for the unit **44** between the electrodes **18** as long as the resistance value of each unit **44** is correct. Fine tuning of the resistance value of each unit **44** can be achieved by shortening or lengthening one or both of the legs **46**, **48** to change the overlap length, L.

Assuming a touchscreen to be utilized for signature recognition, annotation, drawing or any other purpose which may require the user to input continuously varying positional data, the portion covered by conductive portion **20** (see Figure 1) is made active by the switch means **26**. The operation of the switch means **26** also makes the conductive portion **20A** inactive. Thus, writing or other input can proceed over portion **20** to obtain position information by the circuitry **14** without any input from portion **20A**. Thus, the palm, the edge or the heel of the hand which rests on portion **20A** provides no input to the circuitry **14**, thus there is the desired discrimination. Of course, since if

one or more portion is not active, it will not respond to touch by an object of any size even as small as that in contact with the active portion. If the entire touchscreen is needed for position determination, the switch means **26** can be activated to a condition so that both conductive portions **20**, **20A** are connected to the circuitry **14**.

It will be understood that similar operations can be achieved using a touchscreen having additional or differently shaped conductive portions, as in Figures 2 and 3. Obviously, the invention is not limited to just two or three conductive portions.

Another conventional type of resistive touchscreen to which the present invention is applicable is illustrated in the exploded view of Figure 5. This type of touchscreen utilizes a pair of confronting resistive layers **50**, **52**. The layers **50**, **52** are typically separated by dot separators (not shown). Electrical potentials are applied to layer **50** with edge electrodes **54**, **54A**. Layer **52** is divided into two portions **52A** and **52B** by an insulating line **56** in a manner similar to that illustrated in

Figures 1-3. Accordingly, electrical potentials are applied to layer **52** through edge electrodes **58**, **58A**, **58B**, and **58C**.

As discussed below, layer **50** can similarly divided into separate portions (see Figure 6). As will be known by persons skilled in the art, the various edge electrodes are connected to circuitry (not shown but of the type utilized for the embodiment of Figure 1) whereby the appropriate voltages are fed to the electrodes to provide the electrical potentials in proper orientation and timed sequence. In a manner similar to that utilized for Figures 1-3, the separate resistive layer portions **52A** and **52B** are connected to linked switches shown in Figure 5 to cause the portions to be active or inactive to achieve any desired touch discrimination. It will be understood that the resistive layer **52** can be divided into a greater number of portions, also.

Referring to Figure 6, this is a plan view illustrating how the two resistive layers **50**, **52** can each be divided. The under resistive layer **52** is illustrated as being oriented orthogonally with its illustration in Figure 5.

Thus, the insulative line **56** is across the figure to produce the two portions **52A**, **52B**. The upper resistive layer **50** is divided by an insulative line **60** into the two portions **50A**, **50B**. The edge electrodes of each layer **50**, **52** are connected to the circuitry and switch means (not shown) for providing voltages to the electrodes in a desired timed sequence, and for selecting active and inactive portions of the total touchscreen. Both layers **50**, **52** can be separated into any selected number of portions to provide a desired position discrimination.

From the foregoing, it will be understood by persons skilled in the art that improved touchscreens have been developed that permit discrimination between contact by different objects of any size in different portions. This is achieved by subdividing at least one of the contacting sheets into a selected plurality of portions, each portion connected to a switch means so as to be "activated" or "inactivated" for providing inputs to a circuitry for determining touch position on the touchscreen. Thus, the present invention is not another class of the touchscreen/switch combinations

described in the prior art. Rather, it is a whole new category of touchscreens.

Although specific embodiments have been described for use of the present invention, this is not for the purpose of limiting the invention. Rather, the invention is to be limited only by the appended claims and their equivalents.

Claims

I CLAIM:

1. A resistive position touchscreen for providing information as to a point of touch by an object, and selectively discriminating against contact of other objects, said touchscreen comprising:

first and second closely spaced and separated sheets, said sheets contacting each other at a point when touched by an object at that point, at least one of said sheets divided into a plurality of electrically separated regions;

a resistive layer applied to at least one of said first and second sheets on a surface facing another of said sheets, said resistive layer having a selected substantially uniform resistivity throughout said layer;

field generating means connected to opposite edges of said resistive layer for producing electrical fields in said resistive layer;

a circuit means for applying voltages in proper timed sequence to said field generating means, and for receiving and analyzing signals

from said plurality of separated regions to ascertain information as to a point of touch; and

a switch means connected to each of said separated regions to selectively connect at least one of said separated regions with said circuit means whereby a selected portion of said resistive layer is active for providing information as to the position of touch of the object.

2. The touchscreen of Claim 1 wherein a resistive layer is applied to confronting surfaces of both said first and second sheets, each said resistive layer having a substantially uniform resistivity throughout; and

wherein said field generating means is connected to opposite edges of said resistive layer on said first sheet and to opposite edges of said resistive layer on said second sheet to effectively provide intersecting electrical fields in said touchscreen in a selected alternating timed sequence.

3. The touchscreen of Claim 1 wherein said resistive layer is applied to said first sheet, said second sheet having a conductive layer confronting said resistive layer, said conductive layer being divided into said plurality of electrically separated regions; and

wherein said field generating means is connected to both opposite edges of said resistive layer to provide within said resistive layer alternating intersecting electrical fields in a selected time sequence.

4. The touchscreen of Claim 2 wherein one of said resistive layers is divided into said plurality of electrically separated regions.

5. The touchscreen of Claim 2 wherein said resistive layers of said first and second sheets are each divided into said plurality of electrically separated regions.

6. A resistive touchscreen for providing information as to a point of touch by an object, and selectively discriminating against

contact of other objects, said touchscreen comprising:

a resistive layer having a selected substantially uniform resistivity throughout said layer, said resistive layer defining perimeter edges;

field generating means connected proximate said perimeter edges of said resistive layer for producing intersecting electrical fields in said resistive layer;

a conductive layer overlaying and uniformly spaced from said resistive layer for contacting said resistive layer when touched by the object, said conductive layer divided into a plurality of electrically separated conductive regions;

a circuit means for applying voltages in proper timed sequence to said field generating means, and for receiving and analyzing signals from said plurality of conductive regions to ascertain the information as to the point of touch; and

a switch means connected to each of said conductive regions to selectively connect at least one of said conductive regions with said circuit means whereby a portion of said

resistive layer associated with said connected conductive region is active for providing information at said circuit means as to the position of a touch of the object to said connected conductive region, and whereby portions of said resistive layer associated with conductive regions not attached by said switch means to said circuit means are inactive as to providing position information.

7. The resistive touchscreen of Claim 6 further comprising insulator means for preventing inadvertent contact between said conductive layer and said resistive layer.

8. The resistive touchscreen of Claim 7 wherein said insulator means is a plurality of substantially uniformly distributed insulator islands positioned between said conductive regions and said resistive layer, said insulator islands having a height sufficient to prevent said inadvertent contact, and allow contact when said conductive layer is touched by the object.

9. The resistive touchscreen of Claim 6 wherein said resistive layer is supported by a substrate layer.

10. The resistive touchscreen of Claim 6 wherein said field generating means comprises:

a resistance element positioned proximate each of said perimeter edges of said resistive layer, each of said resistance elements having opposite ends joined to proximate ends of adjoining resistance elements, each of said resistance elements comprising a plurality of discontinuous units in electrical contact with said resistive layer, each of said units formed by at least one line of conductive material spaced from a line of conductive material of an adjacent unit do define a separation gap of a selected width and length whereby said width and length of said gap and said resistivity of said resistive layer establish a unit resistance for said units;

connection elements at said joined ends of said resistive elements connected to said circuit means for applying voltage to said joined ends; and

a plurality of electrodes positioned on, and electrically connected to, said resistive layer along a preselected symmetrical path proximate each perimeter edge of said resistive layer, said electrodes each being connected to selected positions along said resistance elements to introduce said orthogonal electric fields in said resistive layer, said electrodes having a selected spacing and each electrode having an effective length along said path to produce a selected voltage gradient at each of said electrodes to compensate for any cumulative voltage drop along said resistance element perpendicular to current flow through said resistive layer during operation of said touchscreen when said orthogonal fields are introduced into said resistive layer.

11. A resistive touchscreen for providing information as to a point of touch by an object, and selectively discriminating against contact of other objects, said touchscreen comprising:

a substrate;

a resistive coating applied to a surface of said substrate, said coating having a

selected substantially uniform resistivity throughout said layer, said resistive coating defining perimeter edges;

field generating means connected proximate said perimeter edges of said resistive coating for producing orthogonal electrical fields in said resistive coating;

a conductive layer overlaying and uniformly spaced from said resistive coating for contacting said resistive coating when touched by the object, said conductive layer divided into a plurality of electrically separated conductive regions;

insulator means for preventing inadvertent contact between said conductive layer and said resistive coating;

a circuit means for applying voltages in proper time sequence to said field generating means, and for receiving and analyzing signals from said plurality of conductive regions to ascertain the information as to the point of touch; and

a switch means connected to each of said conductive regions to selectively connect at least one of said conductive regions with said circuit means whereby a portion of said

resistive coating associated with said connected conductive region is active for providing information at said circuit means as to the position of a touch of the object to said connected conductive region, and whereby portions of said resistive coating associated with conductive regions not attached by said switch means to said circuit means are inactive as to providing position information.

12. The resistive touchscreen of Claim 11 wherein said field generating means comprises:

a resistance element positioned proximate each of said perimeter edges of said resistive layer, each of said resistance elements having opposite ends joined to proximate ends of adjoining resistance elements, each of said resistance elements comprising a plurality of discontinuous units in electrical contact with said resistive layer, each of said units formed by at least one line of conductive material spaced from a line of conductive material of an adjacent unit do define a separation gap of a selected width and length whereby said width and length of said gap and said resistivity of

said resistive layer establish a unit resistance for said units;

connection elements at said joined ends of said resistive elements connected to said circuit means for applying voltage to said joined ends; and

a plurality of electrodes positioned on, and electrically connected to, said resistive layer along a preselected symmetrical path proximate each perimeter edge of said resistive layer, said electrodes each being connected to selected positions along said resistance elements to introduce said orthogonal electric fields in said resistive layer, said electrodes having a selected spacing and each electrode having an effective length along said path to produce a selected voltage gradient at each of said electrodes to compensate for any cumulative voltage drop along said resistance element perpendicular to current flow through said resistive layer during operation of said touchscreen when said orthogonal fields are introduced into said resistive layer.

13. A resistive touchscreen for providing information as to loci of points along a line

of touch by a hand-held object, and selectively discriminating against contact of other objects, said touchscreen comprising:

a substrate;

a resistive coating applied to a surface of said substrate, said coating having a selected substantially uniform resistivity throughout said coating, said resistive coating defining perimeter edges;

field generating means connected proximate said perimeter edges of said resistive coating for producing orthogonal electrical fields in said resistive coating;

a conductive layer overlaying and uniformly spaced from said resistive coating for contacting said resistive coating when touched by the object, said conductive layer divided into a plurality of electrically separated conductive regions, at least one of said regions for receiving the line of touch by the hand-held object and at least one region for supporting the hand;

insulator means for preventing inadvertent contact between said conductive regions and said resistive coating;

a circuit means for applying voltages in proper time sequence to said field generating means, and for receiving and analyzing signals from said plurality of conductive regions to ascertain the information as to the loci of points of the touch; and

a switch means connected to each of said conductive regions to selectively connect at least one of said conductive regions with said circuit means whereby a portion of said resistive coating associated with said connected conductive region is active for providing information at said circuit means as to the loci of points of the touch of the object to said connected conductive region, and whereby portions of said resistive coating associated with conductive regions not attached by said switch means to said circuit means are inactive as to providing position information to discriminate against touch of the hand.

14. The resistive touchscreen of Claim 13 further comprising insulator means for preventing inadvertent contact between said conductive layer and said resistive coating.

15. The resistive touchscreen of Claim 14 wherein said insulator means is a plurality of substantially uniformly distributed insulator islands positioned between said conductive regions and said resistive coating, said insulator islands having a height sufficient to prevent said inadvertent contact, and allow contact when said conductive layer is touched by the object.

16. The resistive touchscreen of Claim 13 wherein said field generating means comprises:

a resistance element positioned proximate each of said perimeter edges of said resistive layer, each of said resistance elements having opposite ends joined to proximate ends of adjoining resistance elements, each of said resistance elements comprising a plurality of discontinuous units in electrical contact with said resistive layer, each of said units formed by at least one line of conductive material spaced from a line of conductive material of an adjacent unit do define a separation gap of a selected width and length whereby said width and length of said gap and said resistivity of

said resistive layer establish a unit resistance for said units;

connection elements at said joined ends of said resistive elements connected to said circuit means for applying voltage to said joined ends; and

a plurality of electrodes positioned on, and electrically connected to, said resistive layer along a preselected symmetrical path proximate each perimeter edge of said resistive layer, said electrodes each being connected to selected positions along said resistance elements to introduce said orthogonal electric fields in said resistive layer, said electrodes having a selected spacing and each electrode having an effective length along said path to produce a selected voltage gradient at each of said electrodes to compensate for any cumulative voltage drop along said resistance element perpendicular to current flow through said resistive layer during operation of said touchscreen when said orthogonal fields are introduced into said resistive layer.

17. A resistive touchscreen for providing information as to a point of touch by an

object, and selectively discriminating against contact of other objects, said touchscreen comprising:

a first resistive layer having a selected substantially uniform resistivity throughout said layer, said first resistive layer defining perimeter edges;

a second resistive layer closely spaced from said first resistive layer, said second resistive layer having a selected substantially uniform resistivity throughout said second layer of a value corresponding to said resistivity of said first resistive layer, said second resistive layer defining perimeter edges, at least one of said first and second resistive layers divided into a plurality of electrically separated regions;

electrical field generating means connected proximate opposite of said perimeter edges of said first and second resistive layers for producing intersecting electrical fields in said touchscreen in alternating timed sequence

a circuit means for applying voltages in proper timed sequence to said field generating means, and for receiving and analyzing signals from said plurality of separated regions to

ascertain the information as to the point of touch; and

a switch means connected to each of said separated regions to selectively connect at least one of said separated regions with said circuit means whereby a portion of said one of said resistive layers associated with said connected separated region is active for providing information at said circuit means as to the position of a touch of the object to said connected separated region, and whereby portions of said resistive layer associated with separated regions not attached by said switch means to said circuit means are inactive as to providing position information.

18. The resistive touchscreen of Claim 16 wherein said first and second resistive layers are separated with a plurality of substantially uniformly distributed insulator islands, said insulator islands having a height sufficient to prevent inadvertent contact between said resistive layers, and allow contact when one of said resistive layers is touched by the object.

19. The resistive touchscreen of Claim 16 wherein said field generating means comprises:

a first pair of electrodes in electrical contact with said first resistive layer at opposite of said perimeter edges;

a second pair of electrodes in electrical contact with said second resistive layer at opposite of said perimeter edges, said second pair of electrodes being orthogonally arranged with respect to said first pair of electrodes; and

connections from said first and second pair of electrodes to said circuit means to receive voltages in a selected timed sequence to produce electrical fields in said first and second resistor layers that are intersecting with respect to each other.

20. The touchscreen of Claim 17 wherein both of said resistive layers are divided into a plurality of electrically separated regions, electrodes of each said separated regions connected to said circuit means.

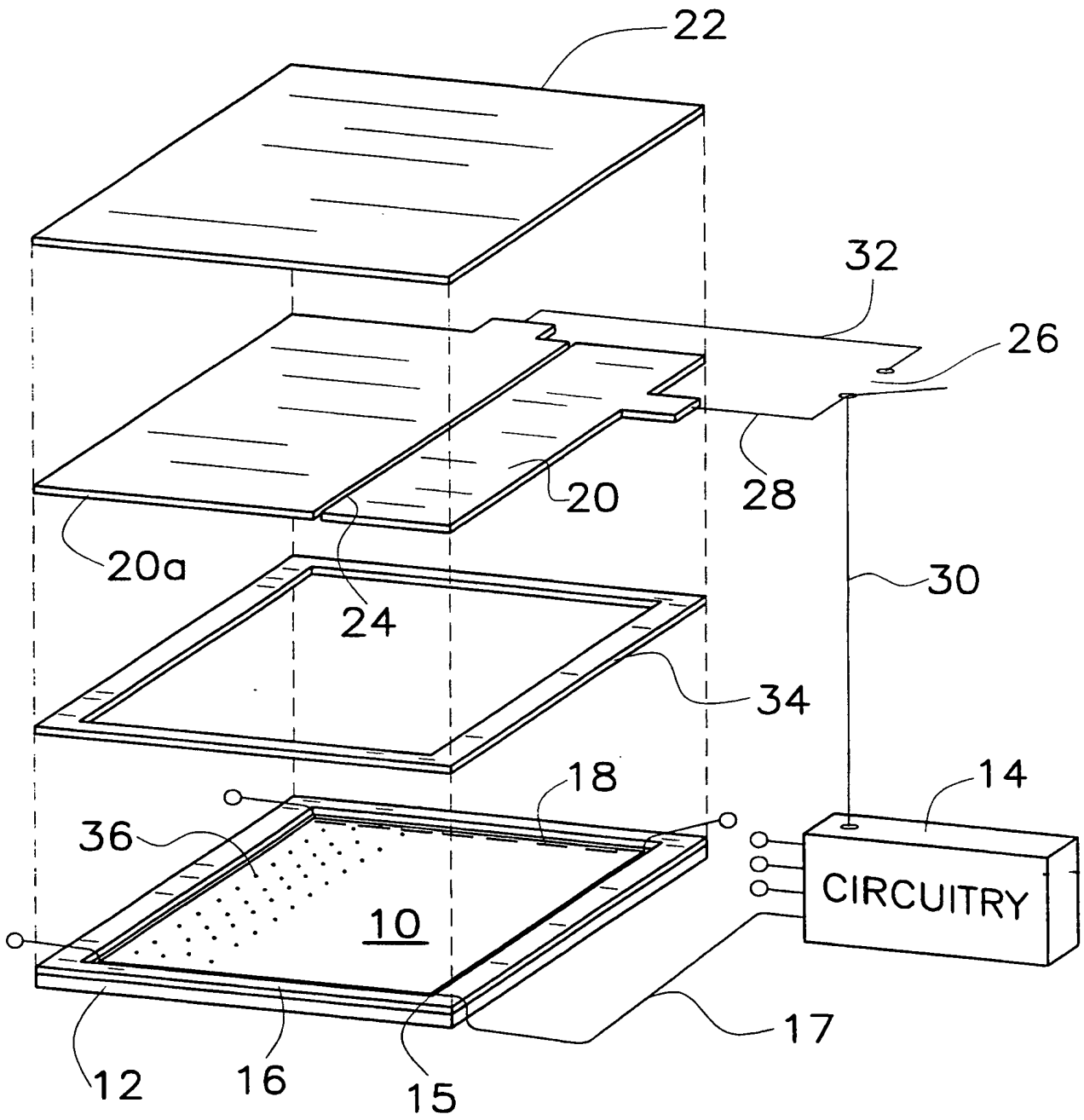


Fig.1

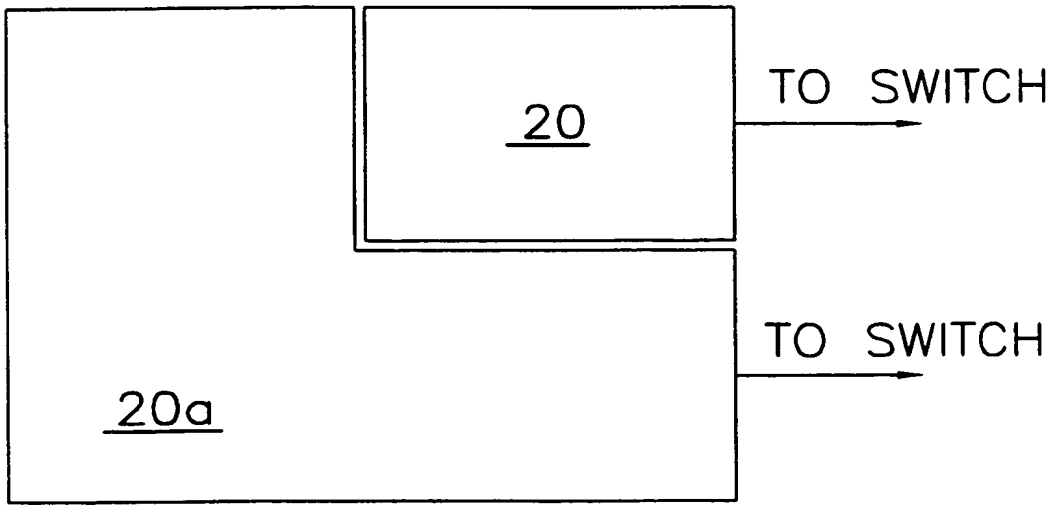


Fig.2

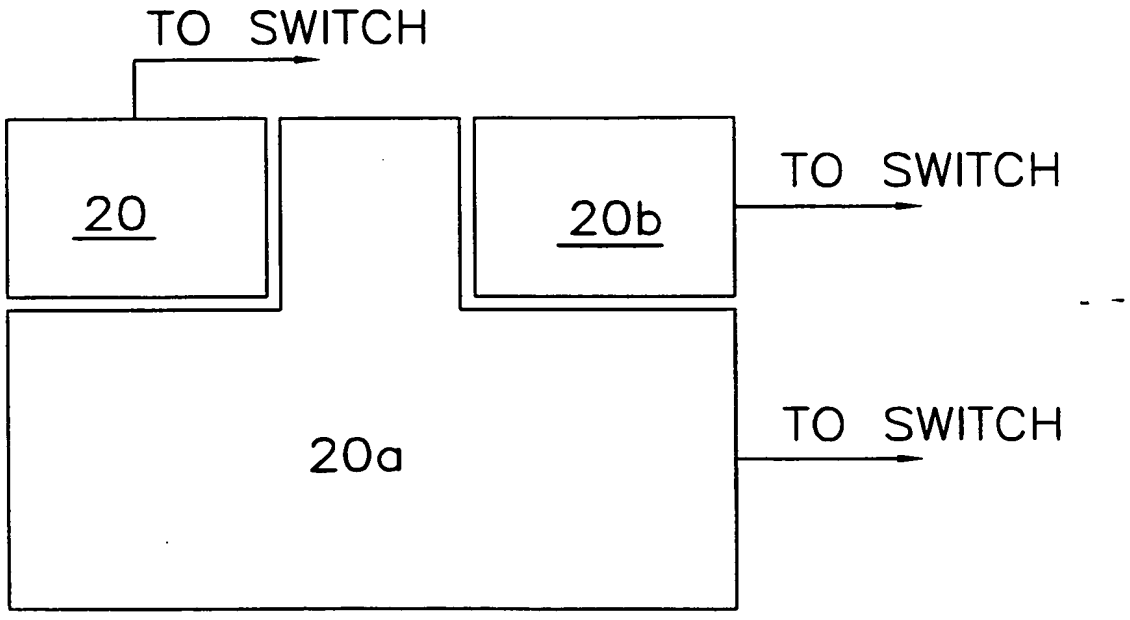


Fig.3

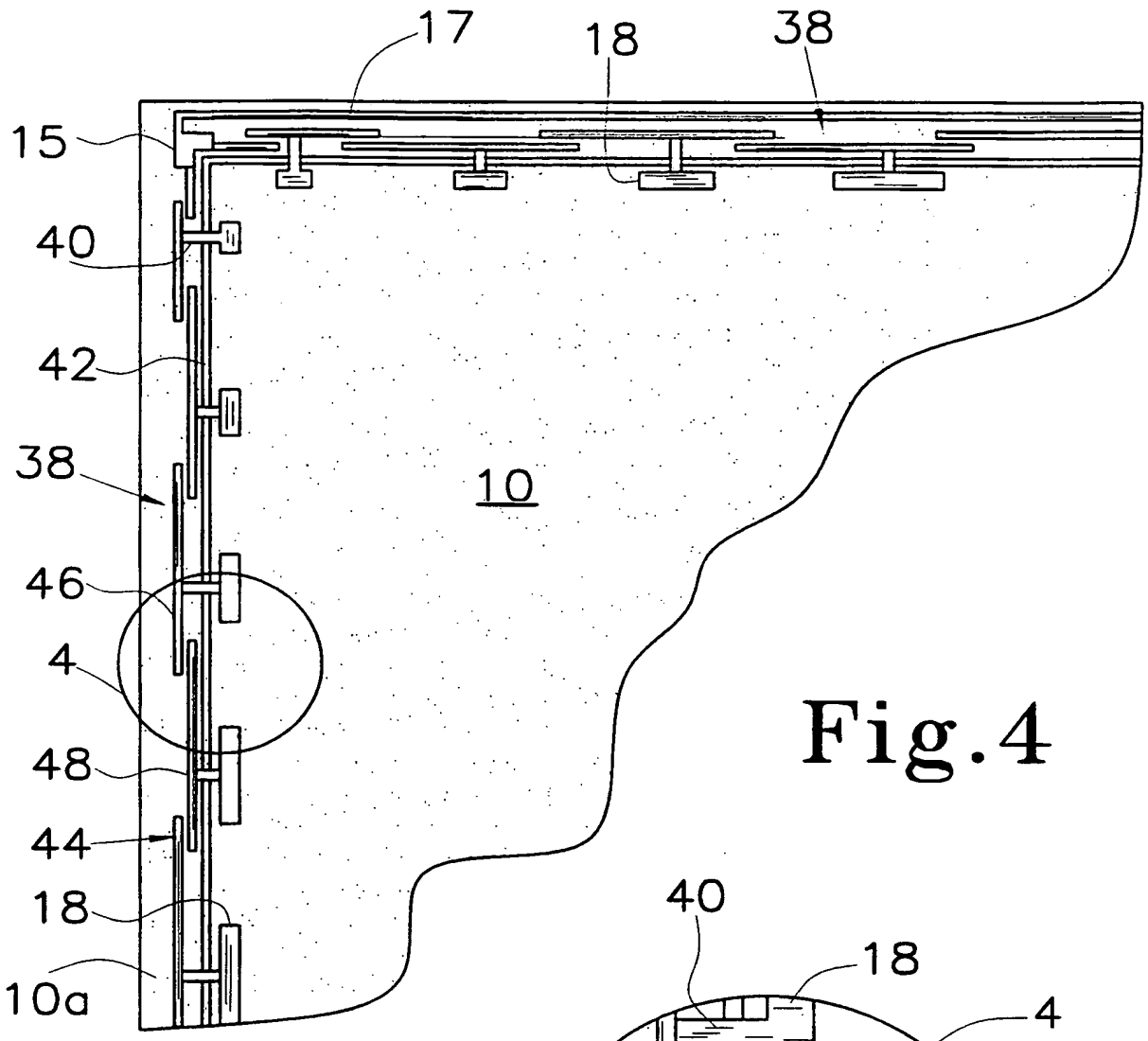


Fig.4

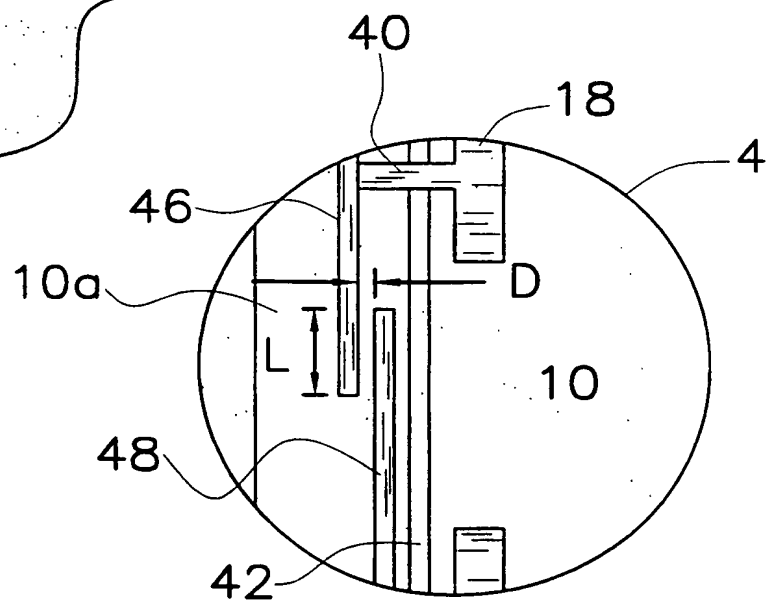


Fig.4a

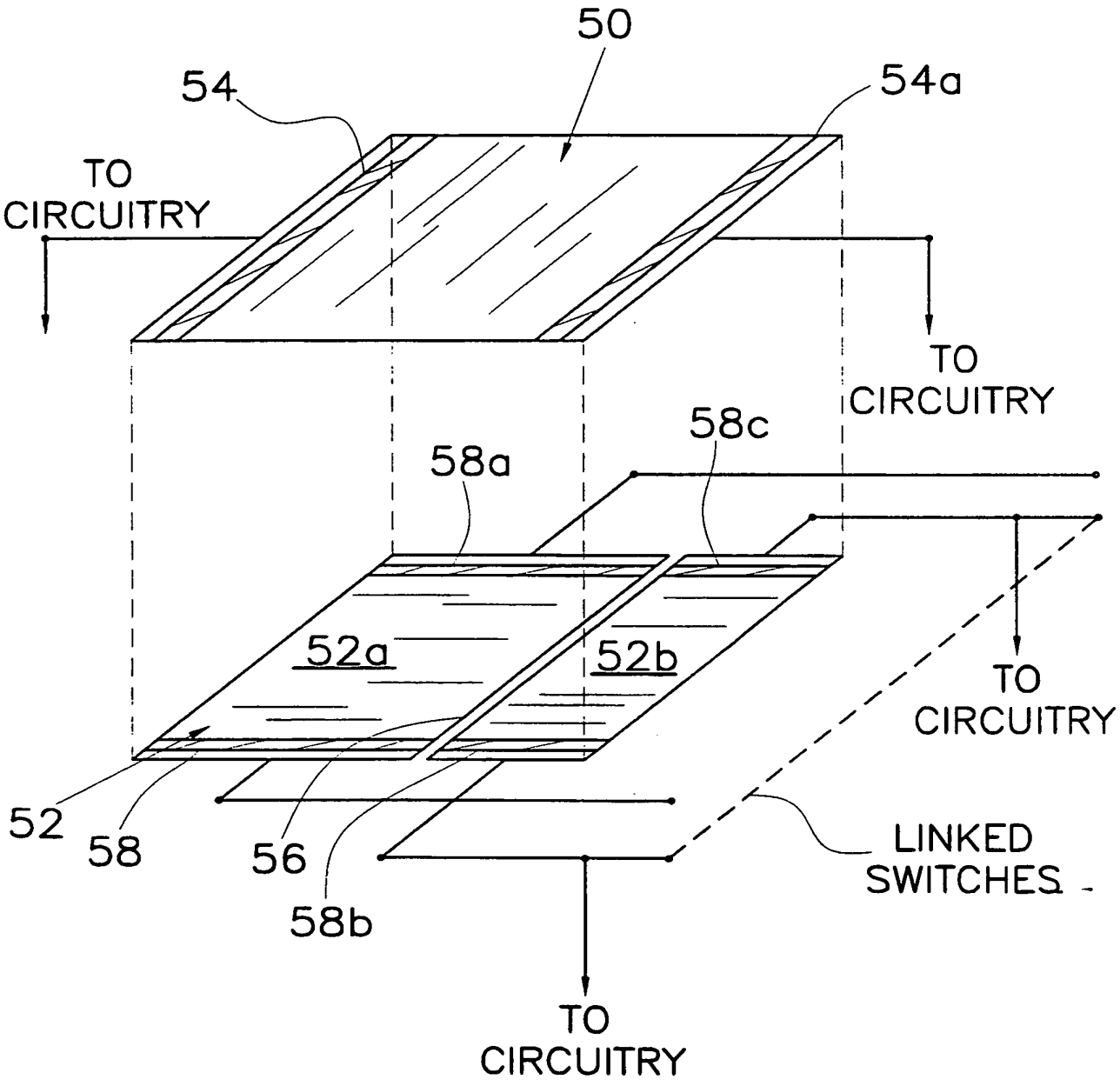
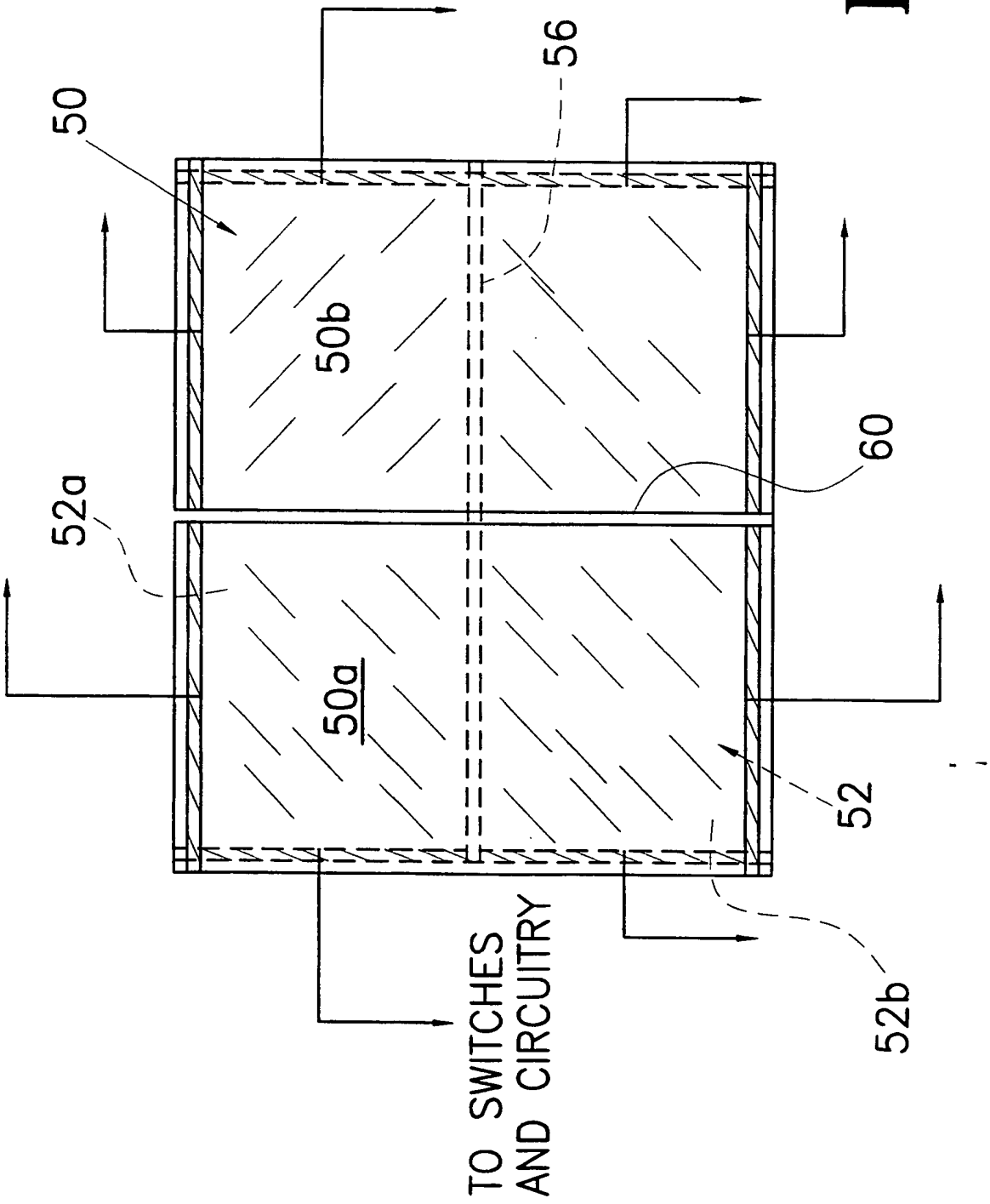


Fig.5

Fig.6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/18755

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G08C 21/00; G09G 3/02
US CL : 178/18,19,20; 345/173,174
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 178/18,19,20; 345/173,174

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,822,957 A (TALMAGE, Jr. et al) 18 April 1989, figures 1,6,6A; col.3,line 58-col.4,line 48; col. 10, line 33-60.	1-20
A	US 5,157,227 A (McDERMOTT et al) 20 October 1992, figures 3-5; columns 5-6	1-20
A	US 5,220,136 A (KENT) 15 June 1993, figures 2-5; columns 5-6.	1-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 08 DECEMBER 1997	Date of mailing of the international search report 24 FEB 1998
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